

Management of Slope Failures Using a Geographical Information System

Presented at



By

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Topics

- ◆ Background
- ◆ Research Methodology
- ◆ Interim Results
- ◆ Direction of Future Work

Highway 71 Relocation (I-540)

- ◆ 69 Km of Interstate Quality Road
 - Two-3.6 m Lanes
 - 3m Right Shoulder
 - 1.2m Left Shoulder
 - 5% Maximum Grade
- ◆ 13 Major Bridges
- ◆ 430m Twin Bore Tunnel
- ◆ \$440 Million Initial Cost
- ◆ \$42+ Million in Slope Repairs



Background

- ◆ Significant Number of Failures
- ◆ Large Maintenance Expenditures
- ◆ Unsightly
- ◆ User Confidence
- ◆ Threat to Safety











Collection of Failure Data

- ◆ Surveys to 10 Highway Districts
 - Location
 - Magnitude
 - Corrective Action
 - Failure Parameters
- ◆ Personal Interviews with Maintenance Supervisors

Data Collectors

David Ross



Wing Fatt Siew



Field Data Collection

- ◆ Global Positioning System
- ◆ Slope Geometry
- ◆ Failure Limits
- ◆ Soil Conditions
- ◆ Drainage
- ◆ Ground Cover



GIS Issues

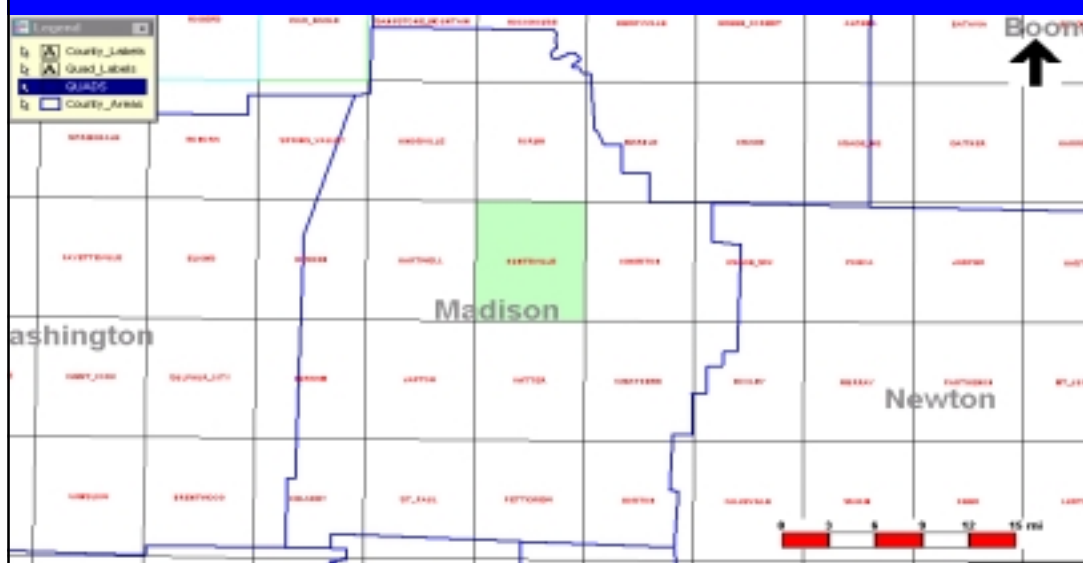
- ◆ MGE
- ◆ Microsoft Access
- ◆ Geo Media
- ◆ MF Works

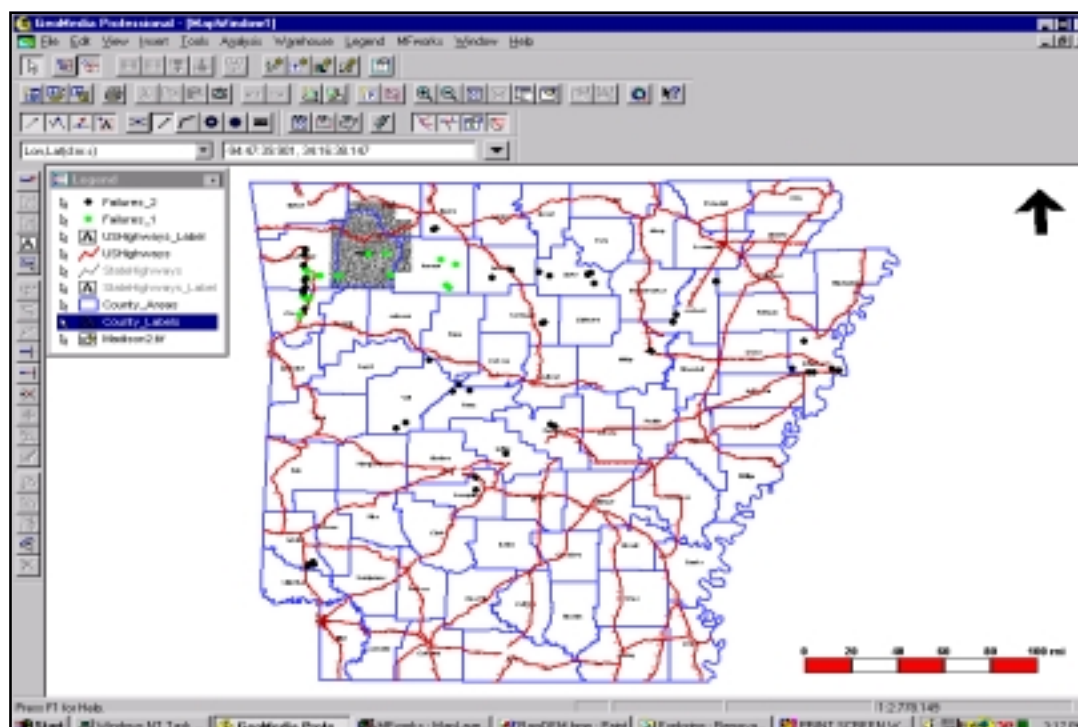
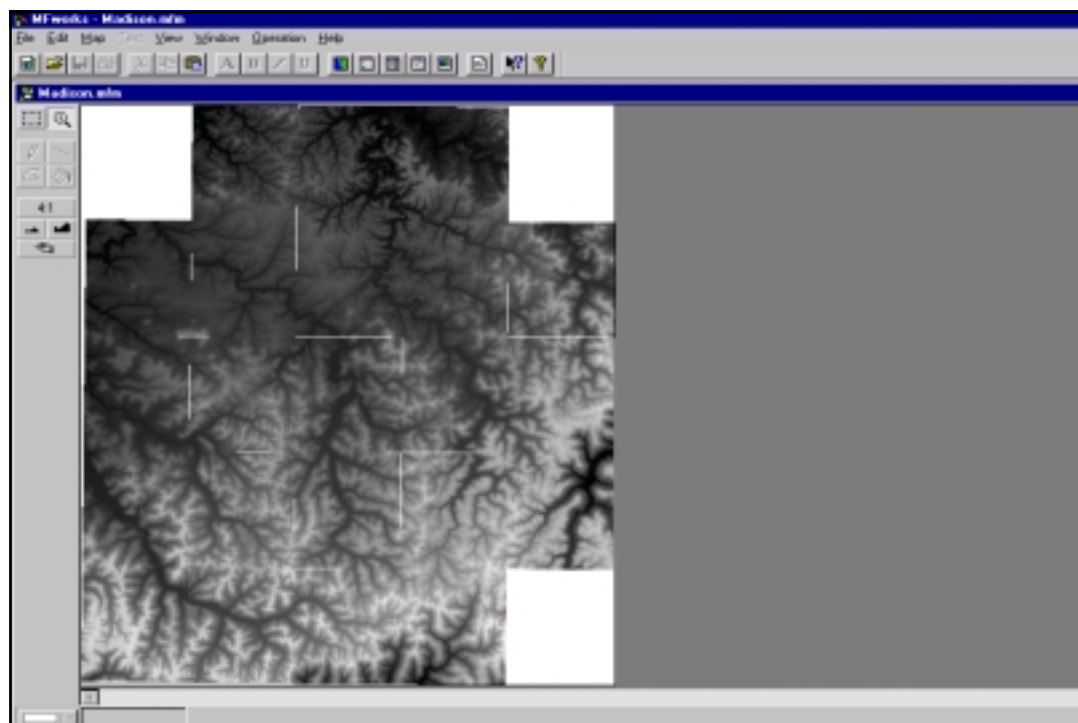
- ◆ Arcview

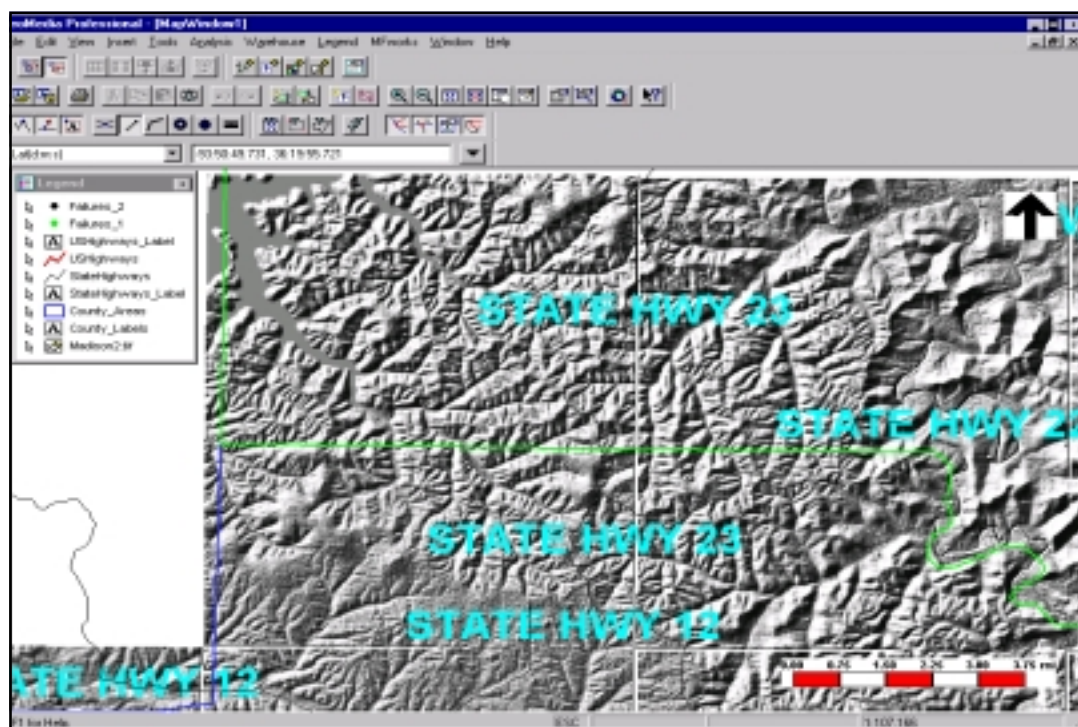
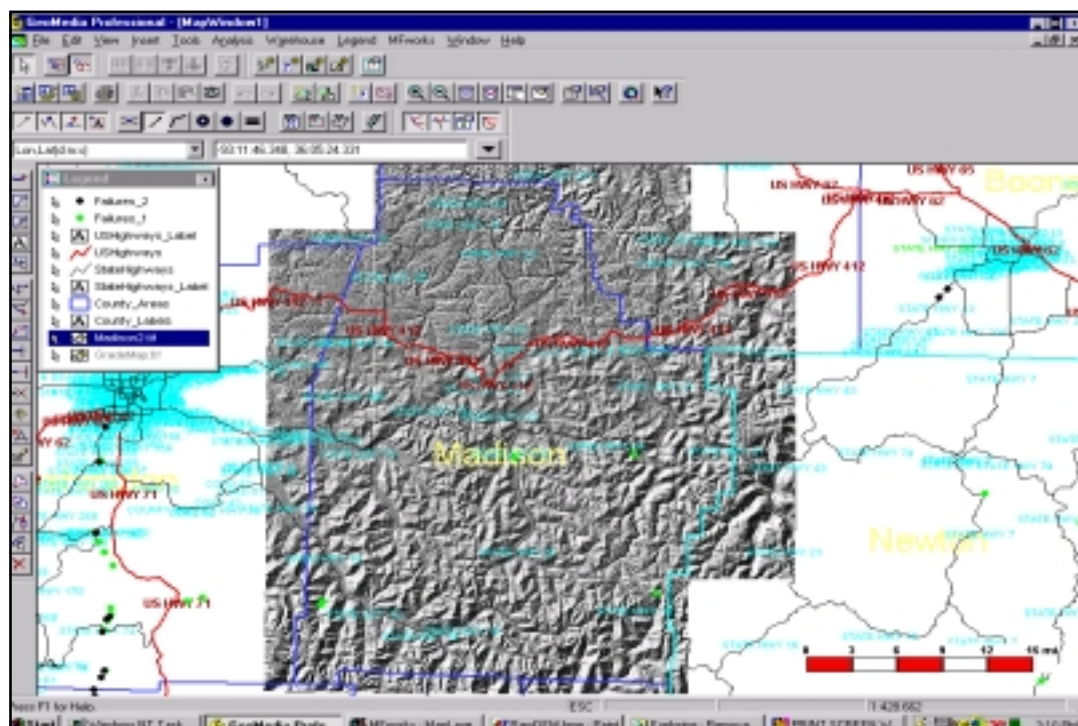
Data Warehouse

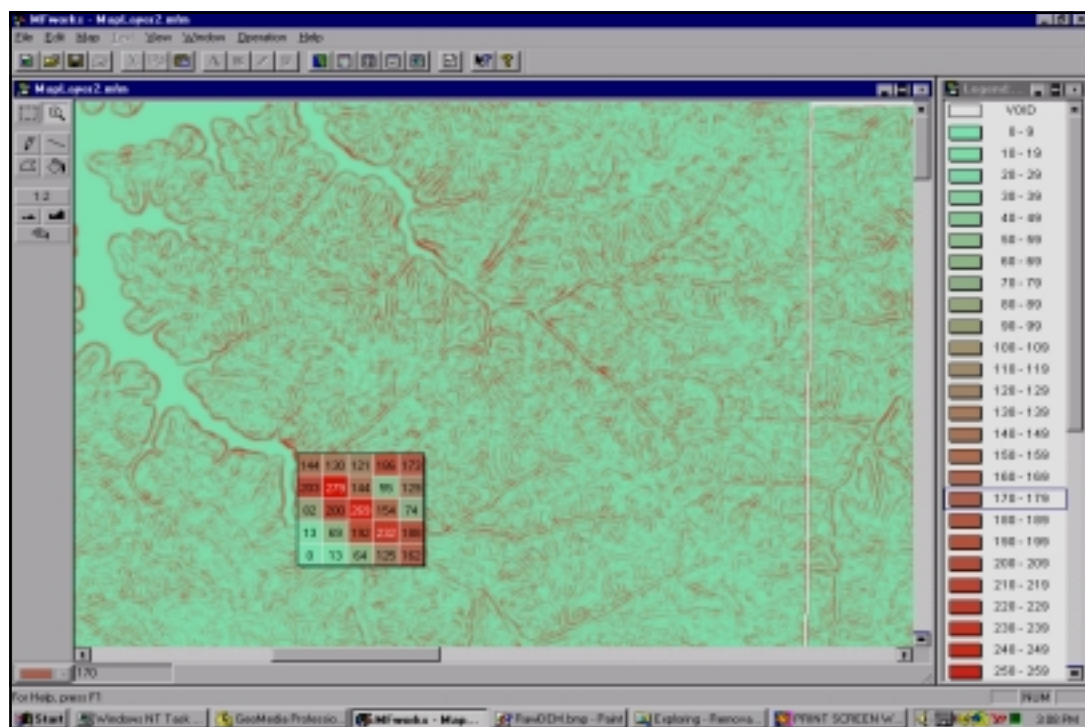
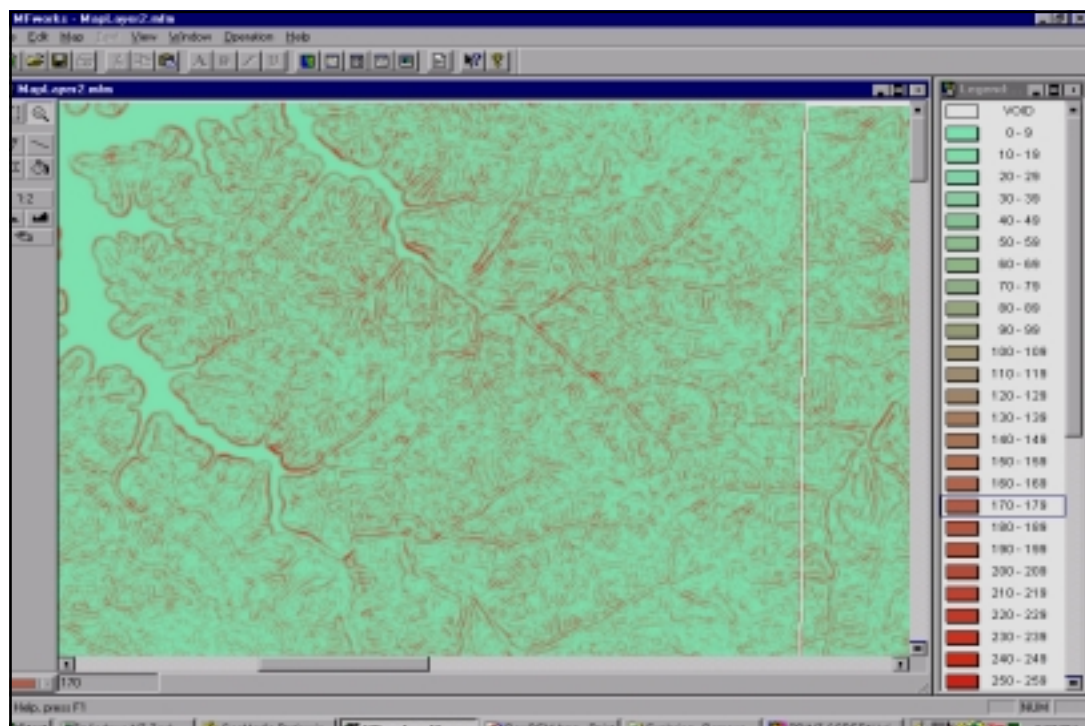
- ◆ Tiger Line Files
- ◆ Streams and Seeps
- ◆ Ground Cover
- ◆ Surface Soils
- ◆ Geology
- ◆ DEM

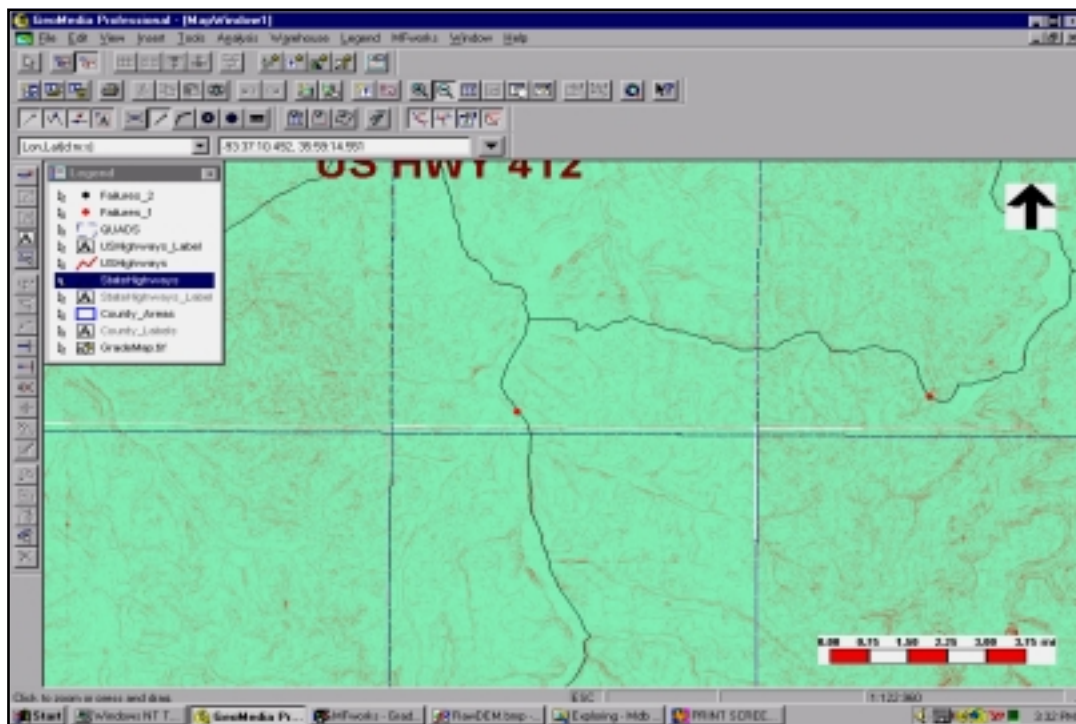
Quadrangle Grid











State Level Soil Data



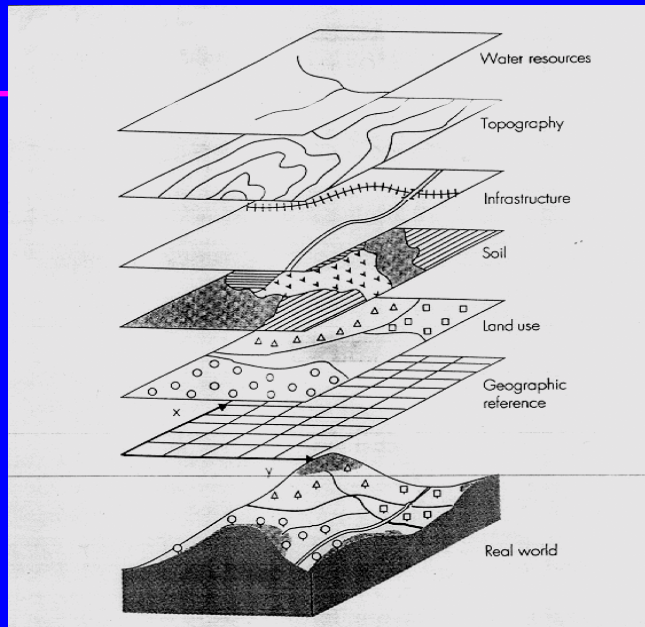
County Level Soil Data

Geological Data

The screenshot displays the ArcView interface with a project named "Failed_1". The legend on the left includes symbols for points, labels, roads, and a detailed list of geological units under "GEOLOGM by DESCRIPTION". These units include Pto-Mohe formation, Pto-Middle part of Pto, Pto-Upper part of Pto, Pto-Bloyd shale, Pto-Boggy formation, Pto-Cane hill member of the hale format, Pto-Hardhome sandstone, Pto-Jackok sandstone, Pto-John valley shale, Pto-McIntire formation, Pto-Savanna formation, Pto-Brownstown shale, Kto-Koe, Kto-Koe, Kto-Koe, Kto-Igous rocks, Kto-Ogan formation, and Kto-Orabaceous rocks. The map itself shows a complex pattern of these colored regions. Labels on the map include "Cason Shale", "Boone Formation", "Washington", "Madison", "Crawford", "Johnson", and "Franklin". A scale bar at the bottom right indicates distances from 0 to 20 miles.

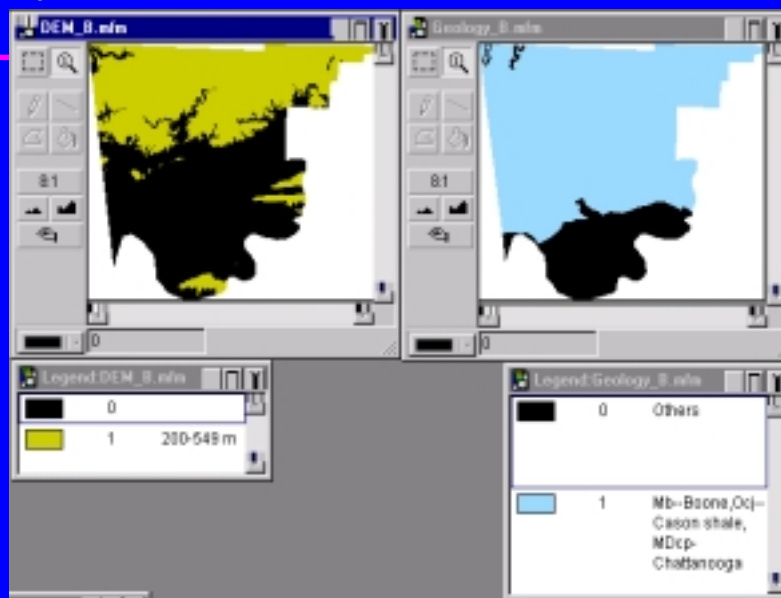
Overlay Analysis

- ◆ County Boundaries
- ◆ DEM
- ◆ Geology
- ◆ Soil
- ◆ Land Cover
- ◆ Water



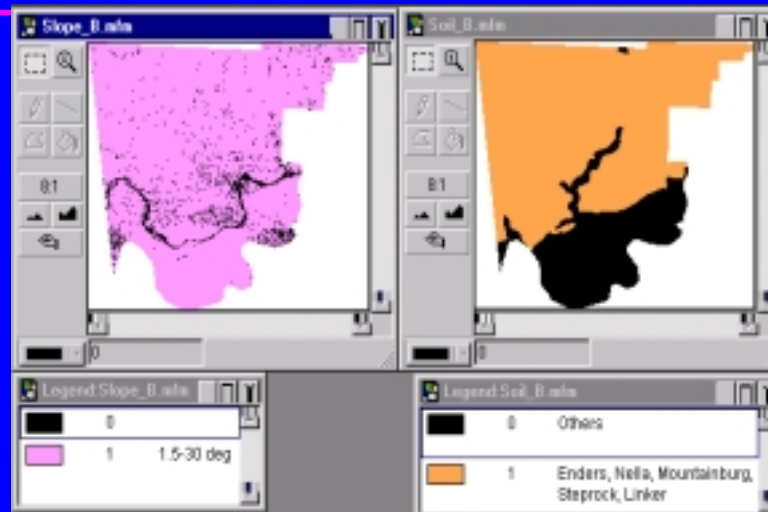
Boolean Layers

- ◆ Elevation
 - 200-500m
- ◆ Geology
 - Boone
 - Carson
 - Chattanooga



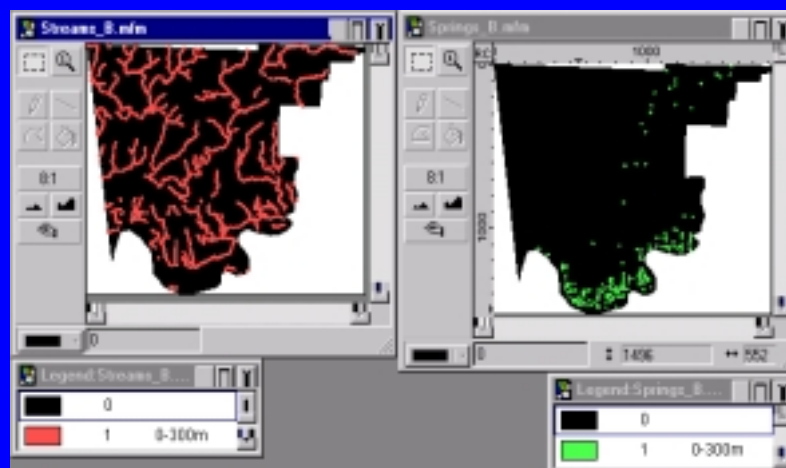
Boolean Layers (cont.)

- ◆ Gradient
 - 1.5-30 %
- ◆ Soil Type
 - Enders
 - Nella
 - Mountainburg
 - Linker

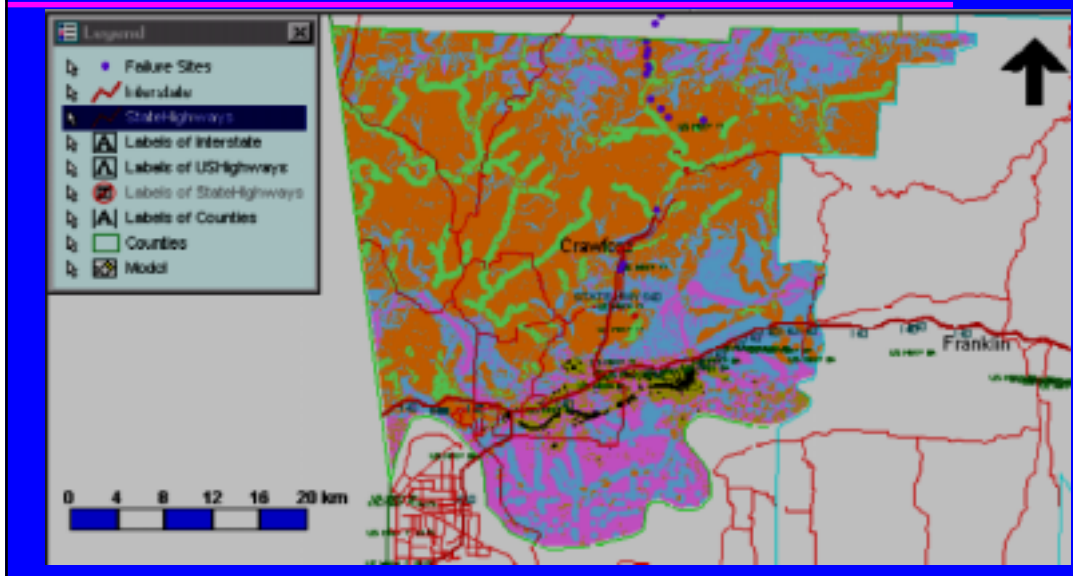


Boolean Layers

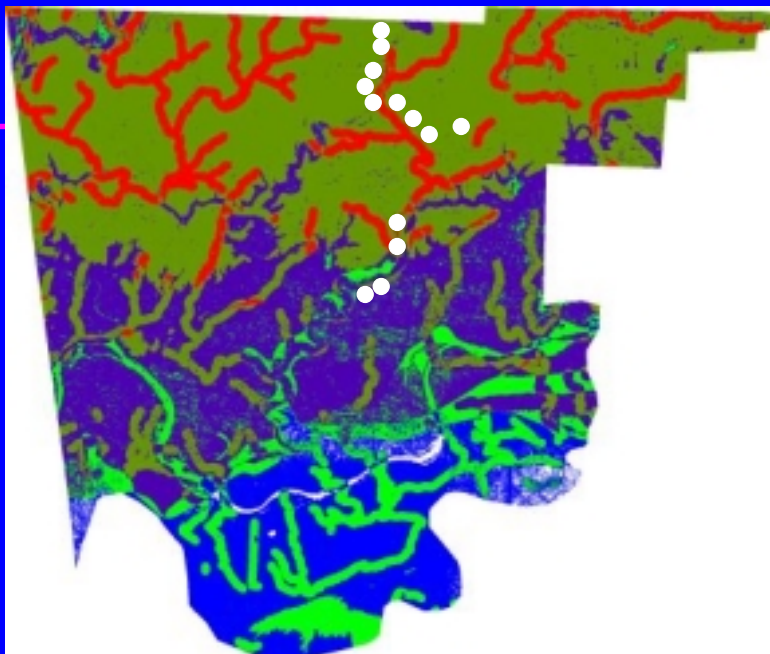
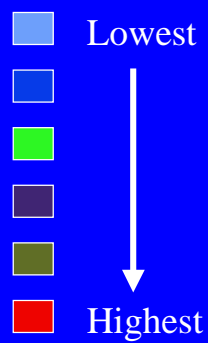
- ◆ Streams
- ◆ Springs and Seeps



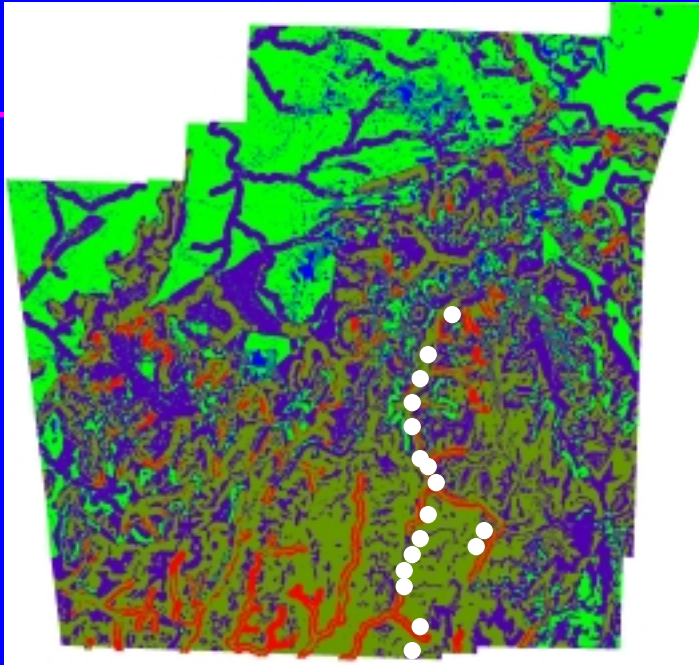
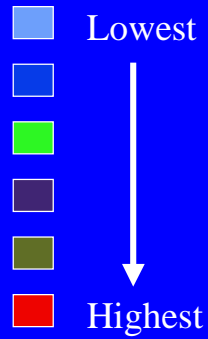
Example of Final Boolean Overlay



Crawford County



Washington County



Conclusions

- ◆ Slope instability prediction using GIS works
- ◆ Prediction models are landform specific
- ◆ Strongest correlation with soil and geology
- ◆ Weakest correlation with elevation and water
- ◆ Prediction models are only qualitative
- ◆ Need higher resolution data

Future Work

- ◆ Add More Slope Failure Data
- ◆ Refine DEM Data
- ◆ Generate Better Water (Seep) Data
- ◆ Refine Soil/Geology Data to County Level
- ◆ Incorporate Ground Cover Data
- ◆ Replace Boolean Queries

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Questions/Comments

